Woolly whitefly, *Aleurothrixus floccosus*, on citrus in South Africa

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**Summary**

Woolly whitefly *Aleurothrixus floccosus* has now been in South Africa for at least six years and can be found on lemon trees in most cities other than in the Free State. The pest is becoming problematic in some commercial citrus orchards and although it does have some natural enemies these cannot provide adequate control where trees are growing vigorously. Although no chemicals are registered a field trial has confirmed that buprofezin, pyriproxyfen and spirotetramat, which are registered against red scale *Aonidiella aurantii* on citrus, will control woolly whitefly if coverage is adequate.

**Distribution and pest status**

Although woolly whitefly, *Aleurothrixus floccosus* (Maskell), is not yet considered a serious pest in most commercial citrus orchards in South Africa, it is becoming well known as a pest of lemon trees in domestic gardens in most cities (Giliomee and Millar 2009). Woolly whitefly is thought to have originated in South America where it is very widespread, but it also occurs in Central America, parts of North America, the Mediterranean countries, Middle East, India, Japan and most of Africa, but not Australia. The earliest unofficial records in South Africa were from around 2006 in the George area. By 2008 it was common in home gardens in Cape Town and had been found in Fort Elizabeth. In 2009 it was discovered in Gauteng and it reached Nelspruit, Mpumalanga in 2010 and North-West Province and Mokopane, Limpopo by 2011. It occurs in Angola and Zambia but has not yet been recorded in Zimbabwe or Botswana. Distribution has most likely occurred via infested plant material.

Woolly whitefly can be readily recognised as the woolly white pest that produces copious amounts of sticky honeydew from the lower surface of leaves of lemon and other *Citrus* species (Fig. 1). Eggs are laid in circles or semi-circles and only on the lower sides of soft, new foliage (Fig. 2). New infestations are therefore associated with growth flushes. Crawlers hatch from the eggs and only move a short distance before settling to feed. There are four instars with the fourth instar being a resting or “pupal” stage. The woolly wax filaments produced by the nymphs are the most diagnostic feature for field identification and...
combined with droplets of honeydew provide a protective covering. Adults have yellowish bodies and white wings and appear similar to many other whiteflies.

Woolly whitefly causes little direct damage to the host plant and does not transmit any pathogens. The main reason for it being a pest is that the honeydew that it secretes supports the growth of black sooty mould that covers leaves and adjacent fruit (Fig. 3). Sooty mould can reduce photosynthesis and stain fruit. Although various types of citrus appear to be the preferred host of woolly whitefly in South Africa, there are other known hosts such as Bougainvillea.

Control
In many other parts of the world, woolly whitefly has been successfully controlled biologically by releasing the parasitic wasp Cales noacki Howard. Although this parasitoid is the most effective known natural enemy of this pest (Katsoyannos et al. 1997; Miklasiewicz and Walker 1990), it is not host specific and has been known to attack one or two other whiteflies (Hoddle 2006). This is most likely because it belongs to a species complex (Motton et al. 2011). It is therefore unlikely that the classical biocontrol programmes that have been conducted in Kenya, Tanzania, Uganda, Malawi and elsewhere will be permitted in South Africa without proof that the natural enemy does not attack indigenous whitefly species. Indigenous natural enemies do help to suppress populations of woolly whitefly in South Africa, especially where trees are not growing vigorously. These natural enemies include ladybird beetles, lacewings, duskywings, and parasitic wasps belonging to the genera Encarsia and Eretmocerus. However, where trees are well fertilised and produce a large amount of new growth, chemical intervention may be required. From international experience (Kerns et al. 2004) and a provisional trial we know that some treatments registered for use on citrus against red scale Aonidiella aurantii (Maskell) and some other citrus pests can be effective against woolly whitefly, e.g., buprofezin, pyriproxyfen, abamectin, chlorpyrifos and neonicotinoids. However, where trees are well fertilised and produce a large amount of new growth, chemical intervention may be required. From international experience (Kerns et al. 2004) and a provisional trial we know that some treatments registered for use on citrus against red scale Aonidiella aurantii (Maskell) and some other citrus pests can be effective against woolly whitefly, e.g., buprofezin, pyriproxyfen, abamectin, chlorpyrifos and neonicotinoids. However, where trees are well fertilised and produce a large amount of new growth, chemical intervention may be required. From international experience (Kerns et al. 2004) and a provisional trial we know that some treatments registered for use on citrus against red scale Aonidiella aurantii (Maskell) and some other citrus pests can be effective against woolly whitefly, e.g., buprofezin, pyriproxyfen, abamectin, chlorpyrifos and neonicotinoids. However, we wanted more information on some of the less disruptive treatments so the following trial was conducted.

Field trial: Method
The trial was conducted in an orchard of two-year-old lemon trees (planted 2009) on CJ Potgieter Boerdery near Kirkwood in the Sundays River Valley, Eastern Cape Province. Five treatments were applied and an untreated control was used (Table 1). One row of 50 trees was used for each treatment. Treatments were sprayed on 13 June 2011 using hand guns equipped with 1.5 mm nozzle orifices and using a pressure of 1 500 kPa. An average of 2.6 L was applied per tree, extrapolating to 1 443 L per ha. A second application of the two entomopathogenic fungi was made one week later on 20 June 2011. An average of 2.4 L per tree was applied, extrapolating to 1 332 L per ha. The trial was evaluated on 7 July 2011. Five infested leaves were picked from each of 10 randomly-selected trees per treatment. Leaves were taken back to the laboratory and placed into dark emergence bags (one per data tree). Eclosing adult woolly whitefly flew into a clear glass vial attached to the emergence bag. Numbers of woolly whitefly which had eclosed were counted on 2 August 2011.

Field trial: Results
All three chemical treatments significantly and substantially reduced woolly whitefly infestation of trees (Table 1). Beauveria bassiana showed no efficacy at all. This was in contradiction to anecdotal reports received from some growers (always as multiple applications). However, as the trees in this trial were very small, conditions for good efficacy with a fungus were not at all favourable: the trees could not create a humid microclimate nor could they provide much protection against UV-irradiation (both important environmental conditions for good efficacy with a fungus). This considered, the experimental Metarhizium anisopliae performed relatively well, reducing infestation by almost 50% (even though this reduction was not statistically significant).

Recommendation
None of the three best treatments included in the above trial are registered against woolly whitefly but they are being used on citrus to control red scale or mealybug. As adult whiteflies only oviposit on new foliage these sprays should be applied soon after eggs have been laid on the flush, if timing is not critical for the target pests red scale or mealybug. This will allow for optimal coverage before woolly whitefly nymphs are covered with woolly wax and provide time for the insect growth regulators to work. If woolly whitefly is already protected by wax filaments at the time of application a single spray is unlikely to provide adequate control. Sprays should be applied at high pressure, in order to simultaneously wash away the wax protection. Spot sprays are not recommended, as woolly whitefly can

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Mean adult WWF/tree (5 leaves/tree)</th>
<th>Infested trees (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated control</td>
<td>9.4 a</td>
<td>80</td>
</tr>
<tr>
<td>Buprofezin (Applaud 500 WDG) 30 g</td>
<td>0.1 b</td>
<td>10</td>
</tr>
<tr>
<td>Pyriproxyfen (Scalex 100 EC) 30 ml</td>
<td>0.3 b</td>
<td>10</td>
</tr>
<tr>
<td>Spirotetramat (Movento 240 SC) 20 ml</td>
<td>0.5 b</td>
<td>20</td>
</tr>
<tr>
<td>Experimental Metarhizium anisopliae 13 ml</td>
<td>5.1 ab</td>
<td>50</td>
</tr>
<tr>
<td>Beauveria bassiana (4xe spores/g) 67 ml</td>
<td>10.9 a</td>
<td>90</td>
</tr>
</tbody>
</table>

1 All spray treatments contained the wetter BreakThru 5 ml/100 L water
2 Values followed by the same letter are not significantly different (a = 0.05; Bonferonni LSD multiple range test)
reproduce rapidly and is highly mobile, thus capable of reinfecting an orchard fairly quickly.

References cited


